

DISTRIBUTION OF THE SOUTHWESTERN TOAD (*BUFO MICROSCAPHUS*) IN ARIZONA

Brian K. Sullivan¹

Key words. *Bufo microscaphus*, southwestern toad, Arizona, distribution, amphibian decline, riparian habitat, hybridization.

The current distribution and status of populations of the southwestern toad, *Bufo microscaphus*, are of considerable interest given the suspected decline in anuran amphibians in the western United States (Blaustein and Wake 1990, Sweet 1991). This bufonid, typically associated with riparian habitats in the desert Southwest, is largely absent from much of its former range in southern California (Sweet personal communication). In Arizona and Utah, *B. microscaphus* is known to hybridize with a closely related toad, *B. woodhousii*, and it appears that *B. woodhousii* has replaced *B. microscaphus* at a number of localities (Sullivan 1986). Given the interest in this species and the lack of information on populations in Arizona, I initiated a survey of the distribution of this toad in Arizona in 1990. Herein I present the results of this survey and compare the historic and present distributions of *Bufo microscaphus microscaphus* in Arizona.

MATERIALS AND METHODS

Historic localities were determined by examining all *Bufo microscaphus* present in the following collections (abbreviations follow Edwards 1975): ASU, CAS, CM, LACM, MVZ, UAZ, and UMMZ. Additional historic localities were determined from literature records through 1988 (Price and Sullivan 1988). Historic localities (Fig. 1) throughout the state were surveyed to a limited degree in 1990 and more intensively in 1991 and 1992 (each site was visited on 1–8 occasions). All sites were photographed and searched for toads and larvae during the late winter and spring (February through June). If juvenile or

adult toads were found, they were measured (snout-vent length in mm, SVL), photographed, and released or retained as voucher specimens (deposited in the ASU Vertebrate Collection). If larvae were present, a sample was collected and returned to the laboratory for rearing to allow confident identification (larvae of *Bufo woodhousii* and *B. microscaphus* are difficult to distinguish).

Adult hybrids between *B. microscaphus* and *B. woodhousii* were identified primarily on the basis of morphological variation (Sullivan 1986). *Bufo microscaphus* typically lacks (1) cranial crests, (2) a well-defined dorsal stripe, and (3) dark ventral pigmentation. In addition, given species-specific differences in vocalizations, advertisement calls were recorded in the field and release calls were recorded under laboratory conditions for breeding males. Cloacal temperatures were recorded with a Weber Quick-recording thermometer to allow assessment of temperature effects on vocalizations (Sullivan 1992). Calls were analyzed subsequently following the methods outlined in Sullivan (1992).

RESULTS

North of the Grand Canyon, *B. microscaphus* has been recorded from the Virgin River at Littlefield and from Beaver Dam Wash near its confluence with the Virgin River at Littlefield (Fig. 1). *Bufo microscaphus* has also been recorded from Short Creek near Colorado City (route 389). In 1991 and 1992 *B. microscaphus* were taken at Beaver Dam Wash, 2 km northeast of Littlefield, and in the Virgin River Gorge, 20 km northeast of Littlefield (Fig. 1). *Bufo woodhousii* and hybrids

¹Life Sciences Program, Box 37100, Arizona State University West, Phoenix, Arizona 85069-7100.



Fig. 1. Historic and recent collecting localities for *Bufo microscaphus* in Arizona. Major drainages are labeled. Solid circles (●) represent sites where *B. microscaphus* was observed during 1991-92; solid circles enclosed by squares (◻) represent historic localities (<1990) that were not visited during the study, but likely continue to be occupied by *B. microscaphus* (not all historic localities are indicated). Open squares (□) represent historic sites no longer occupied by *B. microscaphus*; *B. woodhousii* was present at most of these sites.

were also found at both sites. Suitable habitat (i.e., riparian plant growth, water) is no longer present at the Short Creek site.

In west central Arizona, *B. microscaphus* has been recorded from the Big Sandy River (Signal, Wikieup) and its tributaries (Burro Creek, vicinity of the Hualapai Mountains, Trout Creek); the Santa Maria River (route 93 crossing) and its tributaries (Kirkland Creek); and the Bill Williams proper (Alamo Crossing, 1950; Fig. 1). In 1991 *B. microscaphus* was observed and/or taken on the Big Sandy (route 93 crossing), Burro Creek (route 93 crossing), Santa Maria River (crossings at routes 93 and 96), and Kirkland Creek (route 96 crossing; Fig. 1). Breeding aggregations at Burro Creek ($N = 15$ calling males, $N = 3$ ovipositing females) and the Santa Maria River ($N = 10$ calling males estimated at route 93 crossing) on 22 February 1991 indicate thriving populations. Numerous appar-

ently pure *B. woodhousii* were taken or heard calling at Alamo Lake on 12 July 1991; no *B. microscaphus* were observed.

Bufo microscaphus has been recorded from the Hassayampa River at a number of sites: immediately south of Wickenburg, at the Rincon Road crossing (3 km north of Wickenburg), at the box canyon approximately 5 km northwest of Wickenburg, and near Wagoner (Fig. 1). In 1990-92 *B. microscaphus* was observed along the Hassayampa River approximately 5 km southeast of Wickenburg (Fig. 1). Numbers of breeding adults (2-15 males and 3-5 females over a 200-m section of the river during 1990 and 1991) suggest a thriving population. Although *B. woodhousii* was recorded from this site in 1955-56 ($N = 6$ total), on the basis of morphology and vocalizations, none (or possible hybrids) has been noted since 1956. A few adult *B. microscaphus* ($N = 3$) were observed at Wagoner, along the upper Hassayampa in 1990.

Bufo microscaphus have been taken along the Agua Fria River (mouth of Boulder Creek, Rock Springs), upper Turkey Creek (Battleflat south of Mayer), and Cave Creek (2 km north of Cave Creek; Fig. 1). Although Sullivan (1956) found both southwestern and Woodhouse's toads and their hybrids at the Agua Fria River near the mouth of Boulder Creek (Table Mesa road crossing) in 1954, since that time only a single *Bufo microscaphus* has been taken (in 1992); all other individuals have been *B. woodhousii*-like (Fig. 1). Large-breeding aggregations ($N = 10-50$ individuals) of apparently pure *B. microscaphus* were observed in the spring of 1992 along the Agua Fria River 1 km northeast of Black Canyon City.

Bufo microscaphus have been taken from Granite Creek (just north of Prescott), Oak Creek (Sedona), Webber Creek (10 km east of Pine), and the Verde River proper at Perkinsville and the Verde Valley (mouth of Wet Beaver Creek, Fig. 1). A single adult *B. microscaphus* was observed along Webber Creek (10 km east of Pine) in 1990. A single toad was observed on the Simmons Camp Wood road (northwest of Prescott) during the spring of 1991 (Howland personal communication). A breeding aggregation of *B. microscaphus* ($N = 12$ males) was observed at Granite Creek (just east of the route 89 crossing, 2 km northeast of Prescott) on 7 May

TABLE 1. Localities where *Bufo microscaphus* was present in 1991–92: T = township, R = range, S = section.

Site	County	Locality data (T, R, S)
1	Cochise	East Clear Creek at Jones Crossing (T13N, R10E, S10)
2	Gila	Cedar Creek at rte 73 crossing (T, R, and S unavailable)
3	Gila	Tonto Creek at rte 260 crossing (T11N, R12E, S21)
4	Gila	Creek north of San Carlos on road to Sawmill (T, R, and S unavailable)
5	Graham	Bonita Creek north of confluence with Gila River (T6S, R2SE, S16)
6	Greenlee	Upper Eagle Creek northwest of rte 666 on road to Honeymoon (T1S, R2SE, S20)
7	Greenlee	Blue River southeast of rte 666, near town of Blue (T3N, R31E, S22)
8	Maricopa	Hassayampa River, southeast of Wickenburg (T7N, R4W, S20)
9	Mohave	Beaver Dam Wash (T40N, R15W, S5)
10	Mohave	Big Sandy Wash at rte 93 crossing (T15N, R13W, S1)
11	Mohave	Burro Creek at rte 93 crossing (T14N, R11W, S19)
12	Mohave	Virgin River, Virgin River Gorge Campground (T41N, R14W, S15)
13	Yavapai	Agua Fria River, Black Canyon City (T9N, R2E, S35)
14	Yavapai	Agua Fria River at Table Mesa Road crossing (T7N, R2E, S6)
15	Yavapai	Agua Fria River at rte 169 crossing (T13N, R1E, S2)
16	Yavapai	Big Bug Creek, vicinity of Mayer (T12N, R1E, S2S)
17	Yavapai	Black Canyon Creek, north of Black Canyon City (T9N, R2E, S2S)
18	Yavapai	Granite Creek, northeast of Prescott (T14N, R2W, S26)
19	Yavapai	Hassayampa River, vicinity of Wagoner (T10N, R3W, S14)
20	Yavapai	Kirkland Creek at rte 96 crossing (T13N, R6W, S9)
21	Yavapai	Santa Maria River at rte 93 crossing (T12N, R9W, S15)
22	Yavapai	Santa Maria River at rte 96 crossing (T13N, R5W, S17)

1991; larvae and adults were found near Mayer and Dewey, respectively, in 1992. *Bufo woodhousii* occurs sympatrically with *B. microscaphus* in the vicinity of Prescott and Dewey, and there is evidence of hybridization near the latter site.

No *B. microscaphus* were observed at a number of points along the Verde River: near Paulden (1 visit in 1991), approximately 3 km north of Clarkdale (1 visit in 1991), at the mouths of Wet Beaver and West Clear creeks (total of 3 visits in 1990–91), or along the East Verde River at the route 57 crossing and 10 km east of the route 57 crossing (3 visits in 1990–91). Similarly, no *B. microscaphus* were apparent along Oak Creek (south of Sedona) on three visits in 1990–91. Habitats at most of these locations (e.g., lentic aquatic sites) may favor *B. woodhousii*, which has been recorded from the Verde Valley since at least the 1950s. A number of larvae and/or adult *B. woodhousii* were taken at the Verde River (3 km north of Clarkdale), along Oak Creek (near Cornville) and along Wet Beaver Creek (in the vicinity of Lake Montezuma) in 1990 and 1991.

Bufo microscaphus have been taken along East Clear Creek (Jones Crossing) and Silver Creek (5 km south east of Show Low) from the late 1970s through the mid-1990s (Fig. 1). Juvenile *B. microscaphus* were observed

immediately downstream from the Blue Ridge Reservoir on East Clear Creek in May of 1990; larvae were abundant at Jones Crossing of East Clear Creek on 17 July 1991.

In central and east central Arizona, *B. m. microscaphus* have been taken near Tonto Creek (route 260), Cherry Creek (vicinity of Young), near Sawmill (Sawmill Canyon, 17 km east of route 77), the vicinity of Point of Pines (12 km north of the Black River), and the vicinity of Maverick (near Pacheta Creek; Fig. 1). One adult *B. microscaphus* was taken at the route 260 crossing of Tonto Creek (17 July 1991). Two recently metamorphosed juveniles (<25 mm SVL) were observed at Dove tank, near Cottonwood Creek, southwest of Show Low (route 60), on 12 August 1991. Larvae of *B. microscaphus* (verified by lab rearing) were abundant at Cedar Creek (route 73 crossing) on 1 July 1991, and approximately 13 km north of San Carlos (route 170) on 26 July 1991.

Bufo microscaphus have been taken from Eagle Creek (13 km west of Clifton), the San Francisco River (northeast of Clifton), and the Blue River (southeast of Alpine; Fig. 1). Larvae of *B. microscaphus* (verified by lab rearing) were abundant on Eagle Creek, 40 miles northwest of Clifton, on 12 June 1991, and on the Blue River, southeast of Alpine, on 2 July 1991.

TABLE 2. Localities where *Bufo microscaphus* was absent in 1991-92. T = Tawakoni, R = Reynolds, S = Sycamore.

Site	County	Locality data (T, R, S)
1	Gila	East Fork Verde River, east rte 57 (T, R and S unavailable)
2	Gila	Sycamore Creek near Sunflower (T6N, R9E, S17)
3	Gila	Reynolds Creek at rte 285 crossing (T6N, R14E, S18)
4	Graham	Gila River southwest of mouth of Bonita Creek (T6S, R28E, S29)
5	La Paz	Alamo Reservoir, Bill Williams River (T10N, R14W, S2)
6	Maricopa	Cave Creek (T6N, R4E, S9)
7	Mohave	Short Creek at rte 359 crossing, Colorado City (T42N, R6W, S6)
8	Yavapai	Agua Fria River, south of Black Canyon City (TSN, R2E, S)
9	Yavapai	Verde River, northwest of Clarkdale (T16N, R2E, S3)
10	Yavapai	West Clear Creek (T13N, R5E, S13)
11	Yavapai	Wet Beaver Creek at Lake Montezuma (T14N, R5E, S1)
12	Yavapai	Beaver Creek near confluence with Verde River (T14N, R5E, S17)
13	Yavapai	Oak Creek in vicinity of Cornville (T16N, R4E, S26)

DISCUSSION

Populations of *B. microscaphus* in west central Arizona appear to be thriving. However, it is critical to note that demographic data allowing an adequate evaluation of the status of these (or any other) populations are unavailable. During 1990-91, adults, juveniles, and larvae were noted at most of the historic localities (Bill Williams and Hassayampa drainages). Over most of this area there is no immediate threat from hybridization with *B. woodhousii*. However, documentation of *B. woodhousii* at Alamo Lake suggests that areas of hybridization immediately upstream and downstream from the impoundment may have been initiated recently following establishment of lentic habitats preferred for breeding by *B. woodhousii* (Sullivan 1986). It is difficult to predict the outcome of such interactions, but in the absence of further modification of the riparian corridor it is reasonable to anticipate that *B. woodhousii* will remain confined to the general vicinity of Alamo Lake. It should be noted that in contrast to the report of Jones (1981), no *B. woodhousii* were found in 1990-92 on any of the tributaries of the Bill Williams River. Although most of the sites visited were relatively disturbed (human recreational activity, cattle and burro grazing), other than at Alamo Lake, lotic habitats preferred by *B. microscaphus* for breeding predominated.

With respect to the south central portion of the state, *B. microscaphus* is apparently no longer present on the lower reaches of the Agua Fria River or Cave Creek. Along the Agua Fria River, it appears that *B. woodhousii* has replaced *B. microscaphus* to a point just

upstream from Lake Pleasant proper (Table Mesa road crossing). With the documentation of vigorous reproductive activity by *B. microscaphus* at Black Canyon City in 1992, it seems reasonable to conclude that without additional habitat alteration, *B. woodhousii* will be unable to move further upstream from the Table Mesa Road site. The expansion of Waddell Dam should provide an excellent opportunity for testing this hypothesis.

The Verde River Valley (Clarkdale to Camp Verde) is one area in which historic collections (all prior to 1960) documented *Bufo microscaphus*, but where only *B. woodhousii* are present today. The increase in lentic habitats associated with agricultural activities in the Verde Valley presumably has favored the establishment of populations of *B. woodhousii*. It is reasonable to conclude that pure populations of *B. microscaphus* remain intact along the relatively undisturbed and inaccessible sections of the Verde River (e.g., Perkinsville) and its tributaries (e.g., Sycamore Creek). For example, a "pure" breeding aggregation of *B. microscaphus* was observed at Perkinsville on the Verde River on 22 May 1959. However, the extent to which *B. woodhousii* has gained access to the major tributaries of the Verde (e.g., Wet Beaver Creek, West Clear Creek, Oak Creek) remains unclear; *B. woodhousii* is currently present in the lower reaches of all of these streams.

The abundance of larvae at Cedar, Eagle, and Bonita creeks, as well as the Blue River indicates that populations of *B. microscaphus* occur throughout the historic range in this part of the state. *Bufo woodhousii* occurs in the Gila River proper and is thought to hybridize with *B. microscaphus* near the

mouths of both Bonita and Eagle creeks (Sullivan 1986, Minckley personal communication). The present results suggest that *B. woodhousii* has not moved further upstream into the tributaries of the Gila River, but additional study will be necessary to adequately assess the extent of hybridization in this region.

In summary, *B. microscaphus* is present at a number of historic localities, but absent from those where the riparian corridor has been altered dramatically through the construction of impoundments. Unfortunately, only anecdotal data are available on the status of extant populations. Additional study will be necessary to adequately assess population dynamics of this toad across its present distribution.

ACKNOWLEDGMENTS

I thank L. Allison, R. W. Bowker, M. Demlong, E. Gergus, S. H. Hinshaw, J. Howland, T. R. Jones, M. Loeb, J. O'Reilly, and M. Sredl for assistance with locality data. Rob Bowker, M. Demlong, and E. Gergus helped with some observations. This work was supported in part by a Faculty Grant-in-Aid and a Summer Research Grant from Arizona State University, and Contract G10048A from the Arizona Game and Fish Department.

LITERATURE CITED

- BLAUSTEIN, A. R., AND D. B. WAKE. 1990. Declining amphibian populations: a global phenomenon? *Trends in Ecology and Evolution* 5: 203-204.
- EDWARDS, S. R., ED. 1975. Collections of preserved amphibians and reptiles in the United States. Miscellaneous Publications, Society for the Study of Amphibians and Reptiles 3: 1-22.
- JONES, K. B. 1981. Distribution, ecology, and habitat management of the reptiles and amphibians of the Hualapai-Aquarius planning area, Mohave and Yavapai counties, Arizona. USDI, BLM, Technical Note 353. 134 pp.
- PRICE, A., AND B. K. SULLIVAN. 1988. *Bufo microscaphus*, the southwestern toad. Species account. *Catalog of American Amphibians and Reptiles* 415: 1-3.
- SULLIVAN, B. K. 1986. Hybridization between the toads *Bufo microscaphus* and *Bufo woodhousei* in Arizona: morphological variation. *Journal of Herpetology* 20: 11-21.
- _____. 1992. Sexual selection and calling behavior in the American toad (*Bufo americanus*). *Copeia* 1992: 1-7.
- SWEET, S. S. 1991. Initial report on the ecology and status of the arroyo toad (*Bufo microscaphus californicus*) on the Los Padres National Forest of southern California, with management recommendations. USDA contract report, Forest Service, Goleta, California. 198 pp.

Received 21 January 1993

Accepted 15 April 1993